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(71) Applicant
Chubb Electronics Limited

(Incorporated in the United Kingdom)

Western Road, Bracknell, Berkshire RG12 1RG, United Kingdom

(72) Inventor
David William Tindall

(74) Agent and/or Address for Service
R W Obee
Racal Group Services Limited, Group Patents Department, Richmond Court, 309 Fleet Road, Fleet, Hampshire, GU13 8BU, United Kingdom

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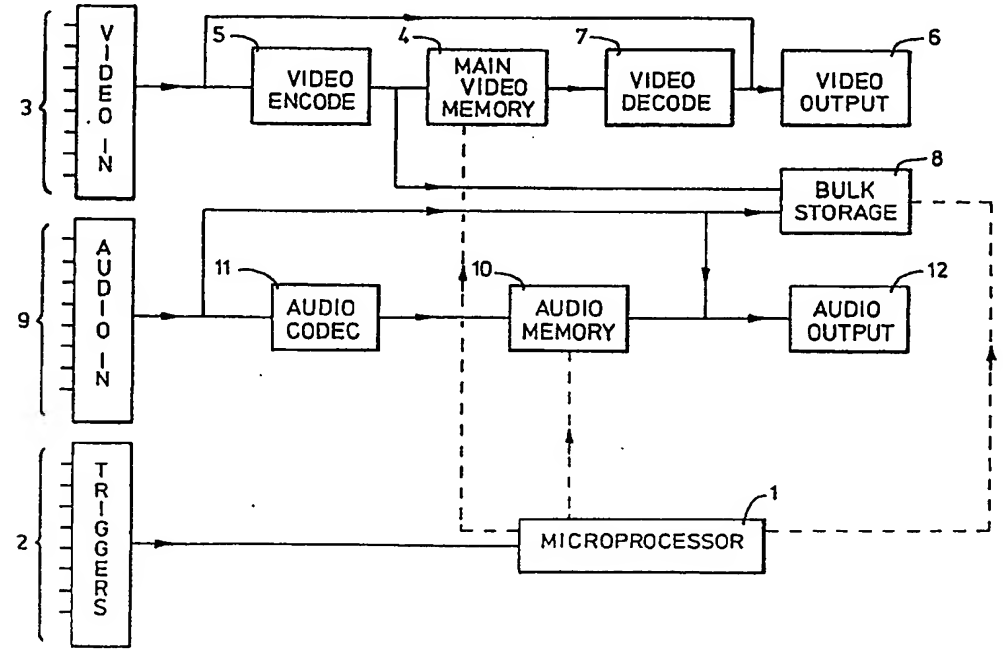
(54) Video surveillance system

(57) A video surveillance system, e.g. for recording intrusion into a monitored zone for subsequent identification purposes, has a series of camera inputs (3) digitally encoded (5) and passed to a solid state image buffer (4). The buffer (4) normally operates in a cyclic mode with the image data passing continuously through it, whereby the contents of the buffer at any one time represent, say, the 25 most recently acquired images from each camera. When any one of a series of intrusion detector inputs (2) is triggered, however, the operation of the buffer (4) is latched to retain a plurality of the successive images which were acquired prior to the detection of the intrusion. Preferably post-detection images are also recorded (8). Retention of the immediately pre-detection images may, however, achieve more reliable verification of the intrusion and identification of the intruders than a system in which images are recorded only after an intrusion detector has responded. The event detectors may be infra-red, ultrasonic, microwave or may even comprise a video processor for detecting changes in the successive images. Audio signals may also be processed in a similar way.



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alarm button or other such means. This might be accomplished by the continuous tape recording of a camera's output throughout the period when the system is "on guard", which for some systems would involve 24 hour operation. This would, however, be very expensive and wasteful since for most of the time the recorded information is of no interest. The system would also demand frequent attention for tape reloading and its continuous operation would result in accelerated wear on the recorder(s) - the mechanical components of which would represent the "weak link" in terms of the reliability of any such system.

The present invention therefore seeks to provide an improved video surveillance system which is configured to acquire and retain "pre-detection" image data in a reliable and cost-effective manner and in one aspect accordingly resides in a system comprising:

at least one camera set up to survey a specified zone and means to derive digitised data representing successive images acquired from said camera;

a solid state buffer for said image data, of a capacity to store a specified plurality of successive images;

at least one event detector adapted to respond to a specified class of significant event occurring within or associated with said zone;

and means for controlling the operation of the system whereby:

(i) while no said significant event is detected said buffer functions in a cyclic mode with said image data passing continuously through it, whereby the contents of the buffer at any one time represent the plurality of

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Video Surveillance System

The present invention relates to video surveillance systems.

The monitoring of e.g. commercial, industrial and military premises or other defined areas for the purpose of detecting intrusion or other significant events has long been practised with the aid of closed-circuit television (CCTV) surveillance systems. When the detection of a significant event is dependent solely on the vigilance of a human operative watching a CCTV screen, however, the reliability of such systems is immediately called into question, as it is notoriously difficult to maintain a sufficient level of concentration and alertness when faced with a scene - or more usually a plurality of scenes - which for most of the time are displaying no significant events. On the other hand, the opportunity for an operative to confirm visually the presence of an intruder or other event confers a significant advantage on CCTV over an alarm system which depends solely on the responses of physical event detectors, all kinds of which can, to a greater or lesser extent and depending upon their conditions of use, respond to stimuli other than those associated with the events wich they are intended to detect, i.e. evoke false alarms.

It is recognised, therefore, that to maximise both the detection and verification of significant events, particularly in the case of a monitored intruder alarm

system, it is desirable to employ both physical event detectors and some means of acquiring image data in relation to the zones supervised by those event detectors. Such systems are known where the display and/or recording of video images from a camera set up to view a supervised zone is initiated by the triggering of an intrusion detector in that zone. The transmitted images can serve to verify to an operative at a remote monitoring station that an actual intrusion has taken place and/or the recording of such images can aid the subsequent identification, apprehension and potential conviction of the perpetrators. Video surveillance systems are also known for recording the scene in the event of a hold-up in a bank or other financial institution, where in this case the commencement of recording is triggered by a member of staff pressing a personal alarm button.

However, such systems where image data is only acquired or recorded from the moment when some other device, or person, has responded to the event in question cannot always be relied upon to provide images in time to capture the event. For example, in the case of an intruder alarm system it may be very difficult to ensure that the field of view of a camera and the coverage pattern of the associated intruder detector(s) are sufficiently well matched, and the speed of response of the detector(s), triggering and recording equipment is sufficiently rapid, to acquire an image of the intruder before he has passed out of the camera's field of view. Again, in the case of a video hold-up system, it may be that the staff will not be able to reach their personal alarm buttons until after the perpetrator has fled.

It is therefore most desirable that, in any such system combining video surveillance with another means of event detection, an image record should also exist of the scene some time prior to the response of the intruder detector,

images most recently acquired from said camera; and

(ii) when a said significant event is detected the operation of said buffer is latched to retain a plurality of said successive images acquired prior to the detection of the event.

In this way, in normal operation of the system the contents of the cyclic buffer will be constantly updated as each successive image is acquired, images acquired more than a certain time ago, and hence no longer of interest, being lost from the buffer as new ones are added. The time for which an individual image remains within the buffer before being lost will be a function of the capacity of the buffer, the number of data bits within an image and the rate of image acquisition. These parameters can be selected with regard to the operational conditions of any particular system to ensure as far as possible that sufficient image data will be residing in the buffer when any significant event is detected to facilitate the desired verification of the event, identification of an intruder or other such matter. Latching of the buffer need not necessarily occur simultaneously with the response of the associated event detector and indeed may preferably occur when a further predetermined number of images have been acquired; the contents of the buffer when latched will therefore then comprise a series of images spanning the period both before and after the event, which may be the most useful for verification or identification purposes. For recording the post-event scene for a more extended period the system may also comprise a video tape recorder controlled to commence recording from the camera in response to the operation of the associated event detector. It will be appreciated, however, that since this apparatus will only be called into use infrequently it should have a much longer service life and require less

attention than in the case of a system involving continuous recording.

In the case of an intruder alarm system with video surveillance in accordance with the invention, the aforesaid event detector(s) may comprise any of the known types of passive infrared, ultrasonic, microwave, glassbreak or other intrusion sensors. It is also possible in a suitable embodiment for this detection function to be performed by video processing means associated with the camera output and adapted to detect changes between successive images indicative of intrusion. In the case of a video hold-up system, the event detector(s) may comprise manually or otherwise personally-operable alarm switches.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawing which is a simplified block diagram of an intruder alarm system with video surveillance according to the invention.

The illustrated system comprises a central microprocessor 1, inputs for up to, say, eight intrusion detectors (or "triggers") 2, video inputs for the same number of CCTV cameras 3, and a main solid state video memory 4. The memory 4 is a large capacity dynamic random access memory (DRAM) which is normally configured as a cyclic buffer. Thus in normal operation single successive frames of digitised image data are acquired from each camera and fed to the memory 4 through which they are cycled until eventually lost. The rate of image acquisition from any particular camera is open to considerable variation and different acquisition rates can be selected for different cameras. However, in a simple example where images are acquired from each camera in turn at the same rate, if the memory 4 has a capacity of, say, 200 frames, at any one time it will contain in this mode of operation the 25 most

recently acquired frames from each camera. Preferably, a video encoder 5 is provided to introduce a level of data compression and thereby reduce the size of memory 4 required to store a given number of frames. The amount of distortion introduced and the level of compression achieved will depend upon the method of encoding employed; as an example this may comprise differential pulse code modulation (DPCM) or transform coding followed by entropy coding. However, if it is assumed that each frame comprises am image of 256 X 256 pixels with each pixel represented on a grey scale of 64 divisions (i.e. a six bit number) and the encoder 5 can achieve a 2:1 data compression without significant image degradation, then the capacity of the memory 4 required to store 200 frames will be in the region of 40 Mbits. A video output port 6 is provided to which a display device can be connected to view directly the outputs of the cameras or to view the contents of the memory 4, after latching as described below, via a suitable decoder 7.

In the event that any one of the trigger inputs receives a signal from its associated detector 2 indicative of the presence of an intruder, the cyclic operation of the video memory 4 is latched under the control of the microprocessor 1. This latching could be effected immediately, so that the retained contents of the memory 4 then comprises the 25 image frames acquired from each camera immediately preceding the detection of intrusion. Normally, however, it will be preferred to delay latching somewhat until a desired number of post-triggering frames have also entered the memory 4, the microprocessor 1 being programmed to control the number of pre- and post-triggering frames being retained, and from which individual camera(s), in accordance with the topography of the individual detector and camera locations. At the same time, a video tape recorder or other bulk storage medium 8 is switched on to record the images acquired from

11 or a selected number of the cameras after those retained in the memory 4.

In parallel with the above-described acquisition and retention of image data, audio data can likewise be acquired and retained. Thus, inputs for up to, say, eight microphones 9 are also provided, together with a solid state audio memory 10. The outputs of the microphones are mixed and then digitized in an audio codec 11 before being fed to the memory 10. The latter in normal operation functions as a cyclic buffer similarly to the video memory 4 and is latched in similar fashion after the detection of an intrusion. An audio output port 12 is provided to relay the sounds from the microphones 9 as they occur, or from the memory 10 after latching, and post-latching sounds can likewise be recorded at 8.

CLAIMS

1. A video surveillance system comprising:

at least one camera set up to survey a specified zone and means to derive digitised data representing successive images acquired from said camera;

a solid state buffer for said image data, of a capacity to store a specified plurality of successive images;

at least one event detector adapted to respond to a specified class of significant event occurring within or associated with said zone;

and means for controlling the operation of the system whereby;

(i) while no said significant event is detected said buffer functions in a cyclic mode with said image data passing continuously through it, whereby the contents of the buffer at any one time represent the plurality of images most recently acquired from said camera; and

(ii) when a said significant event is detected the operation of said buffer is latched to retain a plurality of said successive images acquired prior to the detection of the event.

2. A system according to claim 1 comprising control means whereby said buffer is latched as aforesaid when a predetermined number of further images have been acquired following the detection of a said significant event.

3. A system according to claim 1 or claim 2 further comprising a video tape recorder or other bulk storage medium for recording successive images from said camera

and control means adapted to commence such recording in response to the detection of a said significant event.

4. A system according to any preceding claim wherein said event detector is adapted to respond to the intrusion of a person into said or an associated zone.

5. A system according to claim 4 wherein said event detector comprises video processing means associated with said camera output and adapted to detect changes between successive images indicative of intrusion into said zone.

6. A system according to any one of claims 1 to 3 wherein said event detector comprises a personally-operable alarm switch.

7. A system according to any preceding claim further comprising:

at least one microphone set up to record audio data from said specified zone;

a solid state audio buffer for said audio data, of a capacity to store such data acquired over a predetermined period of time;

and means for controlling the operation of the system whereby:

(i) while no said significant event is detected said audio buffer functions in a cyclic mode with said audio data passing continuously through it, whereby the contents of that buffer at any one time represent the period of audio data most recently acquired from said microphone; and

(ii) when a said significant event is detected the

operation of said audio buffer is latched to retain the audio data acquired during a period prior to the detection of the event.

8. A video surveillance system substantially as hereinbefore described with reference to the accompanying drawings.

9. A method of retaining images of the intrusion of a person into a specified zone comprising:

setting up at least one camera to survey that zone and deriving digitised data representing successive images acquired from said camera;

passing said data to a solid state buffer of a capacity to store a specified plurality of successive images;

operating said buffer in a cyclic mode with said image data passing continuously through it, whereby the contents of the buffer represent the plurality of images most recently acquired from said camera;

detecting the intrusion of a person into said or an associated zone; and

latching the operation of said buffer in response to said detection whereby to retain a plurality of said successive images acquired prior to said detection.

10. A method of retaining images of a hold-up occurring within a specified zone comprising:

setting up at least one camera to survey that zone and deriving digitised data representing successive images acquired from said camera;

passing said data to a solid state buffer of a capacity to store a specified plurality of successive images;

operating said buffer in a cyclic mode with said image data passing continuously through it, whereby the contents of the buffer represent the plurality of images most recently acquired from said camera;

operating a personal alarm switch during or subsequent to the occurrence of the hold-up; and

latching the operation of said buffer in response to said switch operation whereby to retain a plurality of said successive images acquired prior to said switch operation.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9120571.6

Relevant Technical fields

(i) UK Cl (Edition K) H4F - AA,FDG,FDX

(ii) Int Cl (Edition 5) H04N - 5/907,7/18;
G08B - 13/00,13/194,13/196

Search Examiner

D H JONES

Databases (see over)

(i) UK Patent Office

(ii) ONLINE: DERWENT WPI

Date of Search

13 FEBRUARY 1992

Documents considered relevant following a search in respect of claims 1-10

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	US 3885090 A (ROSENBAUM) see line 5 column 1 to line 19 column 2 and Figure 1	1-10
A	GB 2150724 A (HALL) see whole document	7

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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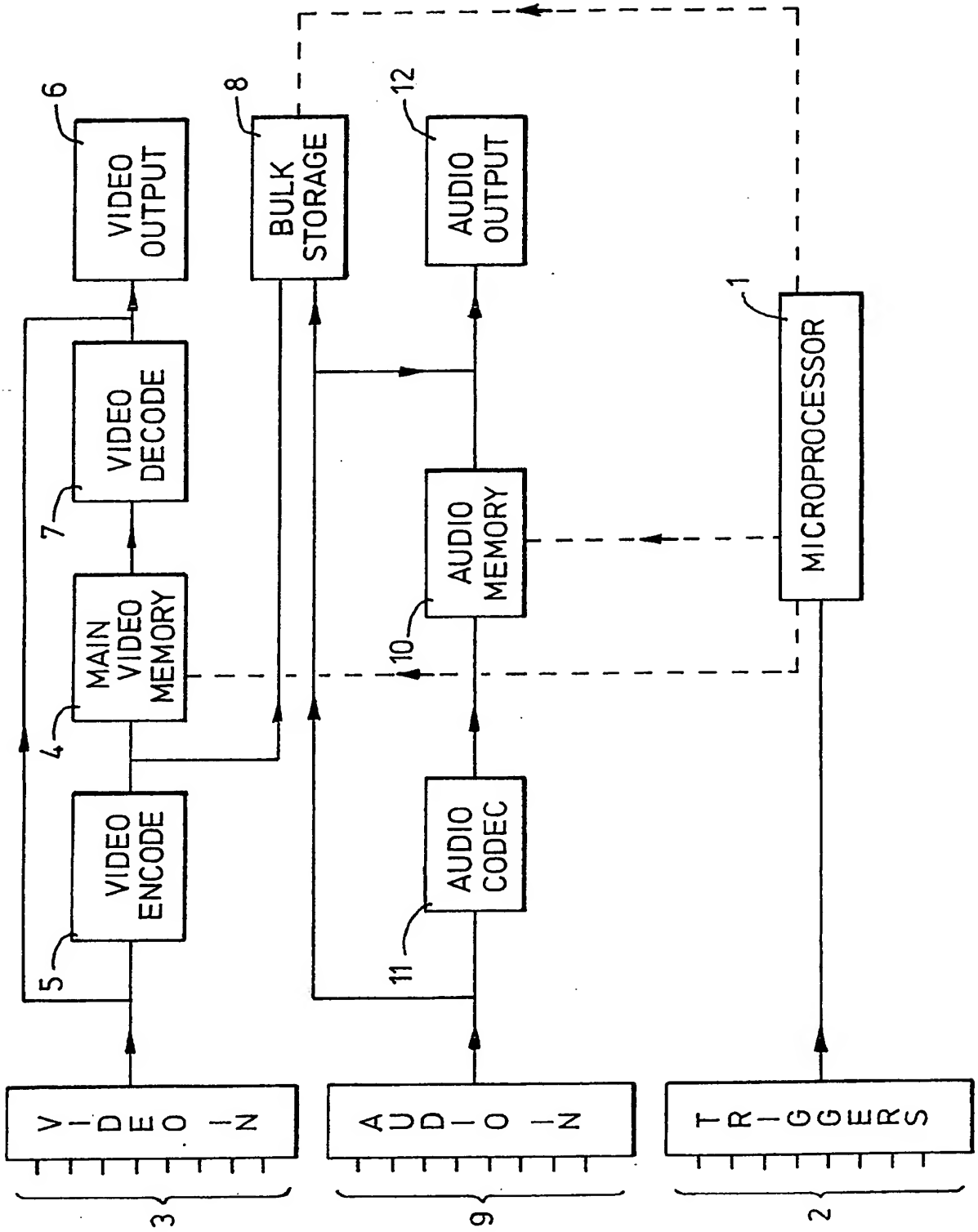
VIDEO OUTPUT
6
BULK STORAGE
8
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12
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1
VIDEO DECODE
7
AUDIO MEMORY
10
MAIN VIDEO MEMORY
4
VIDEO ENCODE
5
AUDIO CODEC
11
V-DEO-N
AUD-O-N
TRIGGERS
3
9
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